

**REMARKS**

Claims 1-5, 8, 10-13, 15, 16 and 19 are pending in this application. By this Amendment, claims 1-3, 13 and 19 are amended to address the rejections under 35 U.S.C. §112, first and second paragraphs, and claim 14 is canceled. No new matter is added by this Amendment.

I. Claim Objection

Claim 19 was objected to for not including the term "ions" after "Fe<sup>3+</sup>." By this Amendment, claim 19 is amended to include the requested term. Withdrawal of the objection is requested.

II. Rejection Under 35 U.S.C. §112, First Paragraph

Claims 1-5, 8, 10-16 and 19 were rejected under 35 U.S.C. §112, first paragraph as allegedly not being supported by adequate written description. This rejection is respectfully traversed.

The Patent Office alleges that the specification does not provide written description of the Fe ion source being an electrode. Applicants disagree. For example, the specification, at page 8, lines 23-30, clearly describes the use of an Fe electrode as a Fe ion source for the phosphate chemical treatment bath.

The Patent Office alleges that the specification does not describe two separate circulating and atmosphere-exposing steps such as separately recited in claims 1 and 13. By this Amendment, claim 13 is amended to refer back to the aspects of claim 1. Claim 13 defines a further aspect of the NO<sub>2</sub> and/or N<sub>2</sub>O<sub>4</sub> removal recited in claim 1. In view of the amendments to claim 13, this rejection is moot.

For at least the foregoing reasons, withdrawal of the rejection is respectfully requested.

III. Rejections Under 35 U.S.C. §112, Second Paragraph

A. Alleged Indefiniteness

Claims 1-5, 8, 10-16 and 19 were rejected under 35 U.S.C. §112, second paragraph as allegedly being indefinite. This rejection is respectfully traversed.

With respect to claim 1, the Patent Office first alleged that the phrase "the metal ion dissolved in said phosphate chemical treatment bath" lacked antecedent basis. By this Amendment, claim 1 has been reformatted with respect to the components of the phosphate chemical treatment bath, one of the components of the treatment bath being recited as "metal ions, wherein a dissolution-precipitation equilibrium potential at which the metal ions in said phosphate chemical treatment bath are reduced and precipitated as metal is equal to or greater than -830 mV." The metal ions in the phosphate chemical treatment bath clearly find antecedent basis in the recitation that the phosphate chemical treatment bath includes such metal ions.

The Patent Office further alleged that the use of parentheses in the phrases "(when said electrode comprises Fe)" and "(when the metal article to be treated comprises a steel material)" was indefinite. By this Amendment, claim 1 has been amended to remove the parentheses.

The Patent Office alleged that the phrase "the electrolytic treatment bath" lacked antecedent basis. By this Amendment, this phrase is amended to "the phosphate chemical treatment bath," which clearly has antecedent basis in claim 1. This amendment also overcomes the Patent Office's allegation that references to "the treatment bath" are indefinite, because the claims clearly include only one treatment bath (the phosphate chemical treatment bath).

Claim 1 is also amended to change the term "treatment liquid" to "the treatment bath", again to provide antecedent basis for the term.

Claim 1 is further amended to change the phrase "separating NO<sub>2</sub> and/or N<sub>2</sub>O<sub>4</sub> gas" to "separating the NO<sub>2</sub> and/or N<sub>2</sub>O<sub>4</sub> gas", thereby providing clear antecedent basis for the phrase.

The Patent Office also found the phrase "in the treatment accompanying electrolytic treatment" indefinite. By this Amendment, claim 1 is amended to delete this phrase.

With respect to claim 2, the above amendments to claim 1 obviate the similar objections to the term "said electrolytic treatment" in claim 2.

Claim 2 is further amended to change "a phosphoric acid" to "the phosphoric acid" for antecedent basis. Finally, claim 2 is amended to recite that the electrode material is "a metal material" to address the antecedent basis concern of the Patent Office.

Claim 3 is amended to address the antecedent basis concern of the Patent Office with respect to the term "a solubility limit."

As discussed above, claim 13 is amended to reference back to aspects of claim 1 for antecedent basis. Thus, the antecedent basis rejection of claim 13 is overcome.

Claims 14 and 16 were alleged by the Patent Office to be duplicate claims. By this Amendment, claim 14 is cancelled.

Claim 19 is amended to change "a Fe electrode" to "the Fe electrode" for antecedent basis.

For all the foregoing reasons, withdrawal of the rejection under 35 U.S.C. §112, second paragraph is respectfully requested.

**B. Alleged Omission of Essential Structural Cooperative Relationships**

Claims 1-5, 8, 10-16 and 19 were rejected under 35 U.S.C. §112, second paragraph as allegedly being incomplete for omitting essential structural cooperative relationships of elements. This rejection is respectfully traversed.

The Patent Office first alleged that claim 1 was rejected because the terms "a phosphate chemical treatment bath", "the electrolytic treatment bath" and "the treatment liquid" were unclear as to how each of these materials related to the other. As discussed above, the claims have been amended to make clear that there is a single phosphate chemical treatment bath, to which the claims now consistently refer.

The Patent Office next alleged that claims 1 and 13 recited two different procedures for removing NO<sub>2</sub> and/or N<sub>2</sub>O<sub>4</sub> gas. As has been discussed above, claim 13 is amended to consistently refer back to aspects recited in claim 1. Accordingly, the relationship between claims 1 and 13 is clear.

For at least the foregoing reasons, withdrawal of this rejection under 35 U.S.C. §112, second paragraph is respectfully requested.

IV. Rejection Under 35 U.S.C. §103(a)

Claims 1-5, 8, 10-16 and 19 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over EP 1 074 640 A1 ("EP 640") in combination with Matsuda (U.S. Patent No. 5,645,706). Applicants respectfully traverse the rejection.

Claim 1 requires, among other features, (1) that the phosphate chemical treatment bath has a pH of 2.5 or lower and is substantially free of metal ions that will form a sludge, (2) that an amount of Fe ions dissolved in the phosphate chemical treatment bath is controlled by changes in the amount of Fe ions dissolved into the phosphate chemical treatment bath from a Fe ion source, the Fe ion source being at least one of (1) an electrode when said electrode comprises Fe and (2) the metal material article to be treated when the metal article to be treated comprises a steel material, so that the phosphate chemical treatment bath does not contain Fe<sup>3+</sup> ions in an amount of more than the solubility limit, (3) that NO<sub>2</sub> and/or N<sub>2</sub>O<sub>4</sub> gas be substantially separated from the treatment bath by way of exposing the treatment liquid to the atmosphere and (4) that the oxidation-reduction potential (ORP) of the phosphate

chemical treatment bath be maintained at 770 mV to 960 mV, with the ORP being used to monitor the phosphate chemical treatment bath. These features are critically important in substantially eliminating sludge formation in the electrolytic phosphate chemical treatment method, and are nowhere found, as combined, in EP 640 and Matsuda.

A. Control of Fe Ions

In the method of claim 1, the amount of  $\text{Fe}^{3+}$  ions dissolved in the treatment bath is controlled so that the treatment bath does not contain  $\text{Fe}^{3+}$  ions in an amount of more than the solubility limit. As detailed in the present specification, if the solubility of Fe ions decreases, for example by exceeding the solubility limit, undesired sludge forms. See, for example, page 19 of the present specification. EP 640 and Matsuda fail to describe or suggest such control.

EP 640 relates to an invention that improves a problem in Matsuda. The improvement is to suppress metal ions other than those that are a component of the film, such as Na ions, in the bath. EP 640 does not describe control of an amount of  $\text{Fe}^{3+}$  ions dissolved in the treatment bath so that the treatment bath does not contain  $\text{Fe}^{3+}$  ions in an amount of more than the solubility limit (and thus sludge is not formed).

In the Office Action, the Patent Office alleged that Matsuda describes  $\text{Fe}^{3+}$  stably present in a solution. In Matsuda, the phrase " $\text{Fe}^{3+}$  is stably present in the bath" means that  $\text{Fe}^{3+}$  is continuously and stably supplied to the bath. It does not mean that the amount of  $\text{Fe}^{3+}$  ions dissolved in the treatment bath is controlled so that the treatment bath does not contain  $\text{Fe}^{3+}$  ions in an amount of more than the solubility limit. At column 13, lines 19-55, Matsuda describes:

If the treatment is limited to steel materials, then the oxidation-reduction potential of the chemical treatment bath reflects the entirety of the various equilibrium systems in the treatment bath, but reflects Chemical Equation 4 as regards the  $\text{Fe}^{2+}$  ion. That is, if the amount of a soluble metal ion, particularly  $\text{Fe}^{2+}$ , is increased, then the oxidation-reduction potential will be reduced, while conversely if the amount of soluble metal ion, particularly  $\text{Fe}^{2+}$ , is decreased, then the oxidation-reduction potential will be increased. Also, if during non-electrolysis there is no supply of energy such as heating,

etc., then an oxidation-reduction potential will not reach 560 mV or greater. This is because the AgCl electrode potential according to the present invention is about 210 mV less than the hydrogen standard electrode potential, and an ORP (AgCl electrode potential) of 560 mV corresponds to 770 mV in terms of the hydrogen standard electrode potential, and that potential reflects the equilibrium:

In other words, for an ORP of 560 mV or greater, it is necessary to further oxidize the ferrous ion ( $\text{Fe}^{2+}$ ) dissolved from the iron material. However, if thermal energy is not directly used to form the coating in the non-electrolytic bath, then the only energy supplied to the treatment bath is the energy which accompanies the dissolution of the iron (Chemical Equation 3). With that energy alone, the equilibrium of Chemical Equation 10 cannot be shifted towards the right.

However, since according to the present invention electrical energy is supplied by the electrolytic treatment, the iron is dissolved and oxidized by Chemical Equations 3 and 10, causing the treatment bath to contain both  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$ , and so the ORP may be 560 mV or greater. In addition, the reaction of the formation of the film (Chemical Equation 4) is also promoted, and thus the formation of the chemical film takes place.

In addition, Table 4 in Matsuda shows a relationship between an ORP of the bath and iron ion state in an electrolytic treatment and a non-electrolytic treatment.

Thus, in Matsuda,  $\text{Fe}^{3+}$  is continuously and stably supplied in the bath. As a result, in Matsuda, sludge is inevitably formed because the solubility product of  $\text{Fe}(\text{OH})_3$  is smaller than that of  $\text{Fe}(\text{OH})_2$  and an amount of Fe ions dissolved in the bath is not controlled. Accordingly, the sludge formed in the bath must be removed.

The phrase " $\text{Fe}^{3+}$  is stably present in the bath" in Matsuda thus does not describe that an amount of  $\text{Fe}^{3+}$  ions dissolved in the treatment bath is controlled so that the treatment bath does not contain  $\text{Fe}^{3+}$  ions in an amount of more than the solubility limit as required in claim 1, and Matsuda does not remedy the deficiencies of EP 640.

#### B. Removal of $\text{NO}_2$ and/or $\text{N}_2\text{O}_4$

EP 640 also fails to describe or suggest the specific method for removing  $\text{NO}_2$  and/or  $\text{N}_2\text{O}_4$  generated and dissolved in the treatment bath during the electrolytic treatment as required in claim 1, wherein removal is effected by separating a treatment tank into an electrolytic treatment tank where the electrolytic treatment is carried out and an auxiliary tank

where no electrolytic treatment is carried out, circulating the treatment bath between the two tanks, and providing a mechanism that opens the treatment bath to the atmosphere at a reduced pressure either between the two tanks or within the two tanks. EP 640 merely describes thermodynamically stabilizing the treatment bath or removing solids from the treatment bath (see claims 24 and 25).

Matsuda does not remedy this deficiency of EP 640. Thus, EP 640 and Matsuda also fail to describe this required feature of claim 1.

C. ORP of 770 mV to 960 mV

EP 640 and Matsuda also do not describe maintaining the ORP of the phosphate chemical treatment bath at 770 mV to 960 mV as required in claim 1.

As discussed above, the present specification describes that maintaining the ORP in the recited range enables the solubility of the Fe ions to be maintained, and thus sludge formation is avoided. Neither of EP 640 or Matsuda describe this feature of claim 1.

In the Office Action, it was noted that if an ORP of 800 mV or more is used,  $N_2O_4$  gas generation may be avoided. However, even if this is the case, it is still also necessary to maintain control of the amount of Fe ions as discussed above, a feature not described in EP 640 or Matsuda.

EP 640 discloses only a phosphate treatment method in which pH is broadly disclosed to be 0.5-5.0; and wherein ORP is broadly disclosed to be 200-1000 mV. In particular, EP 640 discusses the advantages of a wide pH range in order to accommodate a composition of the treatment bath. In fact, EP 640 specifically discloses a preference for pH higher than 4.0. See EP 640 at paragraph [0218]. Additionally, EP 640's overly broad disclosure of 200-1000 mV ORP fails to specify the criticality of an ORP of greater than 770 mV. Each of Examples 1-5 of Table 8 in EP 640 discloses an ORP of less than 400 mV. This makes sense because EP 640 discloses a method in which reactions for other than film formation occur in the bath.

For example, Fe proceeds to  $\text{Fe}^{3+}$  which causes sludge. Nowhere does EP 640 disclose prohibiting the formation of excess  $\text{Fe}^{3+}$ , thereby prohibiting non-film forming reactions. Likewise, EP 640 nowhere discloses substantially separating  $\text{NO}_2$  and  $\text{N}_2\text{O}_4$  from the treatment bath.

Thus, EP 640 nowhere discloses or suggests the claimed specific combination of pH and ORP values, in combination with 1) separating  $\text{NO}_2$  and  $\text{N}_2\text{O}_4$  from the treatment bath, and 2) controlling the mount of Fe ions. Hence, EP 640 clearly nowhere discloses, inherently or expressly, the combination of the features or advantages of instant claim 1. Matsuda fails to remedy the deficiencies of EP 640 with respect to at least claim 1.

For at least the foregoing reasons, claim 1 would not have been rendered obvious over the combination of EP 640 and Matsuda. Moreover, there would not have been a reason to combine EP 640 and Matsuda, because doing so would not have obtained the features of at least claim 1. Accordingly, reconsideration and withdrawal of the rejection are earnestly solicited.

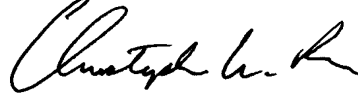
#### V. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-5, 8, 10-13, 15, 16 and 19 are earnestly solicited.



Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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Date: November 30, 2009

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